

CLAIMS

I/We claim:

1. A web forming machine, comprising:

a first rotatable assembly;

a second rotatable assembly positioned in spaced relation relative to the first rotatable assembly, and wherein a gap is defined between the first rotatable assembly, and the second rotatable assembly, and wherein a web of material to be formed is received in the gap; and

means for reciprocally moving the first rotatable assembly into contact with the web, and into mating relation relative to the second rotatable assembly.

2. A web forming machine as claimed in claim 1, and wherein a punch is borne by the first rotatable assembly, and wherein the reciprocal movement of first rotatable assembly causes the punch to penetrate the web to form an aperture.

3. A web forming machine as claimed in claim 1, and wherein a severing tool is borne by the first rotatable assembly, and wherein the reciprocal movement of the first rotatable assembly causes the severing tool to cut the web of material.

4. A web forming machine as claimed in claim 1, and wherein the web of material may be permanently deformed, and wherein a deforming tool is borne on the first rotatable assembly, and wherein the reciprocal movement of the first rotatable assembly causes the deforming tool to deform the web of material.

5. A web forming machine as claimed in claim 1, and wherein a severing tool, deforming tool, and a punch are borne on the first rotatable assembly, and wherein the first rotatable member may be selectively indexed into given orientations relative to the second rotatable member so as to permit each of the severing tool, deforming tool and punch to be reciprocally moved into contact with the web of material.

6. A web forming machine as claimed in claim 1, and wherein the first rotatable assembly comprises a rotatable punch assembly which has an axis of rotation, and an exterior facing surface, and wherein a plurality of punches are borne by the rotatable punch assembly.

7. A web forming machine as claimed in claim 1, and wherein the first rotatable assembly comprises a rotatable punch assembly, and the second rotatable assembly comprises a rotatable die assembly, and wherein the web forming machine further comprises:

a first, selectively actuatable motor disposed in force transmitting relation relative to the rotatable punch assembly and which causes the rotatable punch assembly to rotate to a predetermined orientation relative to the rotatable die assembly;

a second, selectively actuatable motor disposed in force transmitting relation relative to the rotatable die assembly and which causes the rotatable die assembly to rotate to a predetermined orientation relative to the rotatable punch assembly; and

a controller controllably coupled to the first and second selectively actuatable motors, and the means for reciprocally moving the rotatable punch into penetrating contact with the web and into mating relation relative to the rotatable die assembly, and

wherein the controller first causes the rotatable punch and die assemblies to each be positioned in the respective predetermined orientations, and then secondly causes the rotatable punch assembly to reciprocally move into penetrating contact with the web.

8. A web forming machine as claimed in claim 7, and wherein the rotatable punch assembly and the rotatable die assembly each have an axis of rotation, and an exterior facing surface, and wherein the rotatable punch assembly has a plurality of punches positioned at various locations about the exterior surface thereof, and the rotatable die assembly has a plurality of dies positioned at various locations about the exterior surface thereof, and wherein individual punches are operable to mate with individual dies, and wherein the controller selectively actuates the respective first and second motors to rotate the respective rotatable punch assembly and rotatable die assembly so as to substantially coaxially align mating punches and dies.

9. A web forming machine as claimed in claim 1, and wherein the means for reciprocally moving the first rotatable assembly comprises a hydraulic cylinder and moveable ram, and wherein the moveable ram is affixed in force transmitting relation relative to the first rotatable assembly, and is operable to reciprocally move the first rotatable assembly along a substantially linear path of travel into contact relative to the web, and into mating relation relative to the second rotatable assembly to penetrate, sever and/or permanently deform the web of material.

10. A web forming machine as claimed in claim 1, and wherein the first rotatable assembly comprises a rotatable punch assembly which has an axis of rotation, and an exterior facing surface, and wherein at least one punch is moveably borne on the rotatable punch assembly, and is operable to travel along a path of travel from a first position, wherein the at least one punch extends outwardly relative to the exterior facing surface, to a second position, wherein the at least one punch is received substantially internally of the rotatable punch assembly.

11. A web forming machine as claimed in claim 10, and further comprising:
a punch orientation assembly borne by the rotatable punch assembly and which is operable in a first mode of operation to position the at least one punch in the first position, and in a second mode of operation permits the at least one punch to move from the first to the second position:

12. A web forming machine as claimed in claim 11, and further comprising:
a means for placing the punch orientation assembly in the first and second modes of operation.

13. A web forming machine as claimed in claim 10, and wherein the second rotatable assembly comprises a rotatable die assembly, and wherein the web forming machine further comprises:
a punch movement assembly borne by the rotatable punch assembly, and which is operable to move at least one punch along a course of travel which is substantially

parallel to the axis of rotation of the rotatable punch assembly to change the relative position of the punch with respect to the exterior facing surface;

a die movement assembly borne by the rotatable die assembly, and wherein the rotatable die assembly has an exterior facing surface, and an axis of rotation, and wherein the die movement assembly is operable to selectively move at least one die along a course of travel which is substantially parallel to the axis of rotation of the rotatable die assembly; and

a drive assembly borne on each of the rotatable punch and die assemblies, and which is operably coupled to the respective punch and die movement assemblies, and which moves the respective at least one punch and die to a predetermined position relative to the exterior facing surfaces of the respective rotatable punch and die assemblies.

14. A web forming machine comprising:

a work station;

a selectively rotatable and moveable punch assembly positioned above, and in spaced relation relative to, the work station;

a selectively rotatable die assembly positioned below the work station and which is operable to matingly cooperate with the punch assembly;

a web of material selectively positioned in the work station, and wherein the punch assembly is moveable along a path of travel and into penetrating contact with the web and into mating relation relative to the rotatable die assembly;

a computer memory which stores at least one pattern of apertures which are to be formed in the web; and

a controller electrically coupled with the computer memory, and further controllably coupled with each of the rotatable punch and die assemblies, and further controllably positioning the web in the work station, and wherein the controller selectively causes the rotational movement of the rotatable punch and die assemblies and the selective positioning of the web, and further causes the rotatable punch assembly to move along the path of travel and into penetrating contact with the web to form the at least one pattern of apertures which are stored in the memory.

15. A web forming machine as claimed in claim 14, and further comprising:

a severing tool borne by the selectively rotatable and moveable punch assembly, and wherein the controller selectively positions each of the punch and die assemblies in a manner so as to move the severing tool into severing contact with the web of material.

16. A web forming machine as claimed in claim 14, and further comprising:

a deforming tool borne by the selectively rotatable and moveable punch assembly, and wherein the controller selectively positions each of the moveable punch and die assemblies so as to move the deforming tool into deforming contact with the web of material.

17. A web forming machine as claimed in claim 14, and wherein the web of material is selectively moveable along a substantially linear path of travel in the work station.

18. A web forming machine as claimed in claim 14, and wherein the path of travel of the selectively rotatable and moveable punch assembly is substantially perpendicular relative to the web of material when it is positioned in the work station.

19. A web forming machine as claimed in claim 14, and wherein the selectively rotatable punch and die assemblies do not rotate when the rotatable punch assembly moves along the path of travel and into penetrating contact with the web.

20. A web forming machine as claimed in claim 14, and wherein the rotatable punch assembly has an exterior facing surface, and wherein a plurality of punches extend outwardly relative to the exterior facing surface thereof, and wherein the rotatable die assembly has an exterior facing surface, and wherein a plurality of dies are positioned on the exterior facing surface of the rotatable die assembly, and wherein individual punches are operable to operably mate with individual dies, and wherein the controller selectively rotates the rotatable punch and die assembly so as to substantially coaxially align mating punches and dies so as to facilitate the formation of the at least one pattern of apertures in the web.

21. A web forming machine as claimed in claim 20, and further comprising:
a punch orientation assembly borne by the rotatable punch assembly and which is operable in a first mode of operation to position at least one of the plurality of punches in a first position, and wherein the punch extends outwardly relative to the exterior facing surface of the rotatable punch assembly; and wherein the at least one punch orientation assembly has a second mode of operation and wherein the at least one

punch is moveable along a path of travel from the first position, to a second position where the at least one punch is positioned at or below the exterior facing surface of the punch assembly;

means for placing the punch orientation assembly in the first and second modes of operation, and wherein the controller is operably coupled to the means for placing the punch orientation assembly.

22. A web forming machine as claimed in 21, and further comprising:

a punch movement assembly borne by the rotatable punch assembly, and wherein the rotatable punch assembly has an axis of rotation, and wherein the punch movement assembly is operable to move at least one of the plurality of punches along a course of travel which is substantially parallel to the axis of rotation of the rotatable punch assembly to change the relative position of the at least one punch with respect to the rotatable punch assembly; and

a die movement assembly borne by the rotatable die assembly, and wherein the rotatable die assembly has an axis of rotation which is substantially parallel to the axis of rotation of the rotatable punch assembly, and wherein the die movement assembly is operable to selectively move at least one die along a course of travel which is substantially parallel to the axis of rotation of the rotatable die assembly; and wherein the controller is operably coupled in controlling relation relative to the punch and die movement assemblies to selectively position the at least one punch and die in an appropriate orientation relative to the respective rotatable punch and die assemblies to facilitate the formation of the at least one pattern of apertures which is stored in the memory.

23. A method of forming a web, comprising:

providing a web of material having a top and bottom surface;

defining a work station and selectively positioning the web of material in the work station;

providing a selectively moveable and rotatable punch assembly and positioning the moveable and rotatable punch assembly in spaced relation relative to the top surface of the web;

providing a selectively rotatable die assembly and positioning the selectively rotatable die assembly in an adjacent position relative to the bottom surface of the web;

and

forming at least one aperture in the web of material by moving the rotatable punch assembly into penetrating contact with the top surface of the web and into mating engagement with the rotatable die assembly.

24. A method for forming a web as claimed in claim 23, and wherein the step of selectively positioning the web of material in the work station further comprises:

moving the web of material into the work station along a substantially linear path of travel.

25. A method for forming a web as claimed in claim 23, and further comprising:

after the step of providing the selectively moveable and rotatable punch assembly, and before the step of moving the rotatable punch assembly into penetrating

contact with the web of material, indexing the selectively moveable and rotatable punch assembly relative to the top surface of the web material.

26. A method for forming a web as claimed in claim 25, and further comprising:

after the step of providing the rotatable die assembly, and before the step of moving the rotatable punch assembly into penetrating contact with the web of material, indexing the rotatable die assembly relative to the bottom surface of the web of material.

27. A method for forming a web as claimed in claim 26, and further comprising:

providing a computer memory which stores at least one pattern of apertures to be formed in the web of material; and

providing a controller which is electrically coupled to the memory and operably coupled to the rotatable punch and die assemblies, and wherein the controller indexes the respective rotatable punch and die assemblies, and further selectively positions the web of material in the work station, and wherein after the step of indexing, the controller is operable to move the rotatable punch assembly into penetrating contact with the top surface of the web of material and into mating relation relative to the rotatable die assembly.

28. A method of forming a web as claimed in claim 27, and wherein the step of providing the selectively moveable and rotatable punch assembly further comprises providing a plurality of punches which extend outwardly therefrom, and wherein the step

of providing a rotatable die assembly further comprises providing a plurality of individual dies on the rotatable die assembly, and wherein the method further comprises:

providing a punch movement assembly which is borne on the rotatable punch assembly, and which selectively positions at least one of the plurality of punches in different locations relative to rotatable punch assembly; and

providing a die movement assembly which is borne on the rotatable die assembly, and which selectively positions at least one of the dies in different location relative to the rotatable die assembly; and wherein the controller is controllably coupled to the punch and die movement assemblies.

29. A method of forming a web as claimed in claim 28, and further comprising:

providing a punch orientation assembly which is operable in a first mode of operation to position at least one of the plurality of punches in a first position where the at least one punch extends outwardly relative to the rotatable punch assembly, and is further operable in a second mode of operation to facilitate the movement of the at least one punch from the first position, to a second position where a preponderance of the at least one punch is received within the rotatable punch assembly; and wherein the controller is controllably coupled to the punch orientation assembly.